

BEHAVIORAL MIMICRY IN THE TITMICE (PARIDAE) AND CERTAIN OTHER BIRDS

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NUMEROUS examples of mimicry in color and pattern are known in insects. The Batesian type, wherein a harmless animal mimics a truly dangerous or obnoxious species, is of common occurrence. The harmless mimic derives an advantage from the resemblance because enemies, by instinct or conditioning, will tend to avoid the truly dangerous species and anything which they "identify" as the same thing. Cott (1940) has reviewed the theory of mimicry in detail.

Insect mimicry has evolved primarily under the selection pressure imposed by birds. Because most insectivorous birds utilize the sense of vision in their search for food, and because birds have well-developed color perception, the mimicry of insects has evolved primarily with respect to color and pattern.

The titmice and chickadees (Paridae), which nest in cavities in trees, have apparently evolved a defensive reaction to predators which involves a mimic display of the Batesian type. In these hole-nesting birds the adult, when disturbed on the nest, often performs a display which apparently mimics a hissing, threatening snake.

Pickens (1928) described in some detail the postures and hissing sounds made by the Carolina Chickadee (*Parus carolinensis*) when disturbed while incubating. He was impressed with the resemblance between the hiss of the bird and that of a copperhead snake (*Agkistrodon contortrix*). Pickens stressed, as have many other writers, the startling, even frightening, effect on the observer.

Others who have encountered the display in the Carolina Chickadee include Bent (1946:350) who describes the sound as "an explosive little sound like a sneeze." The bird, which had not yet laid eggs, was inside the nest and responded with the hissing sound each time the tree was tapped on the outside. Dickey (Bent, *loc. cit.*) described the sound as a serpent-like hiss, not unlike a black snake, and noted that adults included the hissing sound in their alarm notes when their young were taken from the nest for examination.

Mr. William C. Dilger has kindly permitted the use of the following quotation from his notes on *P. a. atricapillus*. On June 9, 1954, he found a chickadee excavating a nest cavity in a yellow birch on Slide Mountain, Ulster County, New York. The tail of the bird was visible at the entrance as the bird worked to enlarge the cavity. To test the response of the bird, "I placed my hand over the hole and immediately felt pecking on my palm. When I parted my fingers the bird's activities became apparent. It faced the opening and swayed from side to side with wide open beak. Suddenly it would dart at my

fingers and utter a loud hiss at the same time. The effect was very snake-like and quite startling."

Griffee (Bent, *loc. cit.*:343) reports that the Oregon Black-capped Chickadee (*P. a. occidentalis*) responds to an inquiring finger poked into the entrance of the nesting hole with "a hiss and flutter of the wings."

Burleigh (1930:60) records that incubating Oregon Black-capped Chickadees refuse to leave the nest when the nest tree is tapped and will hiss vigorously and thump the sides of the cavity with the wings.

The Mountain Chickadee (*Parus gambeli*), of western North America, has also been found to utilize the "snake display." Grinnell, Dixon and Linsdale (1930:306) describe the response of an incubating bird observed when a slab of rotten wood was removed, revealing the nest. The bird "lunged, at the same time spreading its wings convulsively, and then gave a prolonged hissing sound . . ." The observer watched this performance 19 times. The wall of the cavity was struck by the wings during the convulsive lunge.

The present author elicited the hissing response from a nesting *P. gambeli* at Crescent Meadow, Sequoia National Park, Tulare County, California, on June 29, 1951. Only the hiss could be detected as the nest was in a deep woodpecker hole.

Bent (*loc. cit.*:364) also notes that the Mountain Chickadee is known to respond to disturbance while on the nest with "a loud hissing noise and a rapid fluttering of the wings . . ." Bent (p. 365) quotes Claude T. Barnes as reporting "that five tiny fledglings, in a nest that he examined, 'hissed in the manner of a snake' when he reflected light into the nest."

The Chestnut-backed Chickadee (*Parus rufescens*) was noted by Bowles (1909:56) to respond with a "sudden flutter of wings and fierce cat-like hiss" when he attempted to look into the opening of the nest cavity. Burleigh (*loc. cit.*:61) observed that this species had the same habit as *P. atricapillus* of hissing and fluttering about when the nest tree was rapped.

A Plain Titmouse (*Parus inornatus*) nesting in a bird box "suddenly exploded and hissed" when Mrs. A. S. Allen (1943:155) lifted the lid of the box. Dixon (1949:116) also noted the explosive note which "combines elements of hissing and puffing" given by incubating birds disturbed on the nest.

The present writer had an exceptional opportunity to observe the pattern of behavior accompanying the hissing when a pair of Plain Titmice occupied a nest box provided with a hinged roof. The nest box, located in a low tree near Los Gatos, Santa Clara County, California, was occupied by the birds on April 6, 1952 when nest-building was in progress. On April 14 the hinged lid was raised and a small mirror was held over the opening to permit a view of the interior. The incubating bird raised itself slightly, gaped widely

toward the mirror, spread its wings as far as the walls of the box permitted, and swayed slowly from side to side for approximately 10 seconds—then, with explosive suddenness, jumped upward emitting a loud puffing hiss with bill agape while the wings struck the sides of the nest box with an audible thump.

On several successive days the bird was similarly disturbed and always reacted in the same stereotyped manner. On April 16, for example, the activity was elicited ten times in rapid succession during a period of approximately three minutes.

The entire pattern of swaying movement and hissing sound was strongly suggestive of a snake and undeniably startling. In spite of recurrent observations I found myself repeatedly startled by the sudden upward jump and loud hiss. It is not difficult to believe that potential predators would frequently be frightened by this activity.

The "snake display" has also been recorded for a number of the European species of *Parus*. Jourdain (1929:123), noting Pickens' article, pointed out that the Great Tit (*P. major*), Coal Tit (*P. ater*) and Blue Tit (*P. caeruleus*) produced hissing sounds when disturbed on the nest. Jouard (1932) added the European form of *P. atricapillus* and Hinde (1952:148) noted the display in the Great Tit, Blue Tit and Marsh Tit (*P. palustris*).

Certain species of hole-nesting birds, other than members of the Paridae, have also evolved a hissing "snake-display." The Wryneck (*Jynx torquilla*) has a "snake-like hissing when disturbed on nest . . ." (Witherby, *et al*, 1943 (2):293; Coward, 1920). The nestlings of the Flicker (*Colaptes auratus*) are reported (Sherman, 1910:145) to begin to produce a hissing sound soon after hatching. The noise is uttered constantly, day and night, for approximately two weeks. The young cease the sound about the time they begin to exhibit fear reactions.

The Wood Warbler (*Phylloscopus sibilatrix*) of Europe builds on the ground a domed nest, with a side entrance. The nestlings give an explosive hiss when disturbed. Cox (1930) noted that in 18 instances out of 60 the nestlings hissed simultaneously when he disturbed them.

Writing of caged birds, Brooksbank (1949) records that the Cockatiel (*Nymphicus hollandicus*) will hiss like a snake if disturbed in the nest box.

As Hinde (*loc. cit.*) has remarked, the survival value of the "snake display" is obvious. The occurrence of such a display in hole-nesting species is certainly correlated with the fact that there is but one avenue of entrance and exit. The incubating bird cannot escape from a predator capable of entering the nest opening. A high survival value is thus imposed upon any mechanism capable of inducing escape reactions in the intruder. The proof of the effectiveness of an explosive hiss, with or without an accompanying sudden movement, is found in the fact that this same pattern has evolved independently in

hole-nesting birds of widely different origins. Even the Wood Warbler qualifies since its nest has but a single entrance.

The suggestion was advanced above that the "snake display" constitutes an example of behavioral Batesian mimicry. It may well be argued that an explosive hiss is of itself a startling sound and that mimicry is not necessarily involved. This viewpoint would hold that the occurrence of hissing in snakes and in hole-nesting birds is simply a matter of convergent evolution. The case for mimicry is based on the fact that many snakes are actually dangerous to possible predators on the birds and thus the harmless mimic derives an advantage by its resemblance to the harmful model.

The effectiveness of the hissing sound in frightening mammalian predators is to be found in their demonstrated sensitivity to sibilants. Rayleigh (cited by Pumphrey, 1950) showed that the sound *sss* has most of its energy in the band between 8 and 12 kilocycles per second, to which the human ear is relatively insensitive. This same band of frequencies includes the peak of sensitivity for the rat (*Rattus*). The hiss of a snake is undoubtedly far louder and more frightening to a rat than it is to a man. It is probably safe to assume that other small mammals, including predaceous species, have a sensitivity to sibilants similar to that of the rat. If so, the frightening effect on them of the hissing produced by a hole-nesting bird should be even greater than that experienced by human observers.

The gaping mouth and slow side to side swaying movement would seem to enhance the mimic effect of a snake but, as Hinde (*loc. cit.*:24) indicates, a common threat posture of the Great Tit sometimes involves just these components. Other parids, for example *P. rufescens* (personal observation), also include a side to side swaying motion in their threat postures. It would thus appear likely that the gaping and swaying movements of the "snake display," as given by a nesting parid, have been derived from movements already present in the normal threat postures of the group. An element of mimicry is present in that the gaping and swaying seem always to be included in the "snake display" but are not consistently a part of the normal threat postures. The sudden lunge and accompanying explosive hiss may well be completely new mimic components.

The resultant pattern of the display, seen in the dim light of the nest cavity, would certainly resemble a snake rather than a bird. The intruder would thus receive a series of sign stimuli, all tending to conceal their origin as a bird and to reveal it as a snake. The testimony of many startled human observers indicates the effectiveness of the display. It seems probable that the "snake display" will be found to occur in all of the cavity-nesting Paridae. The extent of its occurrence in other groups of hole-nesting birds is a matter for experimental investigation. It is to be urged that an attempt be made to

observe, and to record in detail, the pattern of movements as well as that of any sounds. It would be of additional interest to determine the point at which the motivation for the display is exhausted, in other words, how many lunges may be elicited from a bird at any one time.

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